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NAVY EXPERIMENTAL DIVING UNIT
321 BULLFINCH ROAD
PANAMA CITY, FLORIDA 32407-7015

IN REPLY REFER TO:

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NAVY EXPERIMENTAL DIVING UNIT

REPORT NO. 9-93

EVALUATION OF BAUER UTILUS 10 AND TRIPLEX PURIFICATION SYSTEMS

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19. ABSTRACT (Continue on reverse if necessary and identify by block number)

In response to reference (1), Navy Experimental Diving Unit (NEDU) tested the BAUER UTILUS 10 High Pressure Air Compressor and TRIPLEX Purification System from June 29 to August 3 1993. The purpose of this test was to determine if the equipment was suitable for the ANU List. The BAUER Utilus 10 driven by a Honda GX 160 gasoline engine delivers acceptable breathing air at a capacity which meets the manufacturer's specification. It is recommended for inclusion on the ANU list.

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I. INTRODUCTION

In response to NAVSEA tasking[1-2] a BAUER PURUS/UTILUS 10 MODEL U10-G compressor and BAUER TRIPLEX Purification System was tested by Navy Experimental Diving Unit (NEDU). The purpose of the test was to:

A. Determine if the compressor and Purification System provides compressed air at the required pressures, flow rates, quality and cleanliness required by the U.S. Navy[3].

B. Determine the adequacy of the manufacturer's information, instructions and guidance for the safe operation and overall management of the compressor.

C. To ensure that the compressor purification system discharged clean breathing air required by the U.S. Navy[3].

II. EQUIPMENT DESCRIPTION

A. GENERAL

The BAUER PURUS/UTILUS 10 MODEL U10-G high pressure, breathing air compressor (Figure 1) is of a three stage, three cylinder, "tee" configuration. All pistons and drive gear are lubricated by an oil throwing, pin type lubrication system. The compressor requires approximately 12 fluid ounces (354 milliliters) of lubricating oil.

The BAUER compressor unit consists of compressor block, filter system and drive motor. The Unit is designed for easy exchange of different power sources.

The drive unit is equipped with a hinged motor plate and a V-belt pulley which facilitates mounting to the compressor torsion bar axle. The compressor block and drive motor can be transported separately. Rotational torque is transferred to the compressor by a single V-belt. The prime mover during this test was a Honda GX160, 5.5 horsepower @ 3,600 RPM, gasoline engine.

Two electric motor options are also available for the H.P. BAUER air compressor. A single phase, 220 volts (U10-E1 model), and a three phase 220 volts (U10-E3 model). Both are rated as 3 horsepower. Electric motors purchased for use with this compressor should comply with Navy Standards for sealed insulation units[4].

The Purification system consists of an Interfilter and a Central filter with TRIPLEX longlife cartridges. The interfilter is installed between the 2nd and 3rd stage. The interfilter is a nozzle which separates water and oil. Small dirt particles are also removed by a centered (porous silica) filter insert. The interfilter requires routine maintenance (periodic draining).

The central filter consists of a separator and cartridge chamber. In the separator (which surrounds the cartridge chamber) oil and water are separated by a pipe nozzle and removed by two manual drain valves. Residual oil and water vapors not drained manually are removed by the TRIPLEX longlife cartridge. The treated air is free of oil, taste and smell. Carbon monoxide is eliminated when

a BAUER filter Part No. 059183-410 is used. The BAUER PURUS/UTILUS 10 comes with 3 manuals; Honda Owner's Manual, the PURUS/UTILUS 10 Operating Instructions, and the BAUER Compressor Workshop Manual.

The UTILUS-10 compressor has a capacity of 99 liters (3.5 scfm) free air delivered at 330 bar (4785 psig). The TRIPLEX filter is rated to have an air processing capability of 3200 cubic feet, which allows 15 hours of use per purification cartridge, when operating at an ambient temperature of 80°F (26.6°C) or less. Cartridge life is reduced by one half when Ambient temperatures are above 80°F (26.6°C).

A pressure maintaining/non-return valve set at 99 bar (1450 psi) is provided down-stream from the central filter system. This ensures that pressure build up occurs in the filters during start up and initial compressor air delivery. This achieves constant, optimum filtering, moisture separation, third stage piston ring expansion/cylinder sealing and prevents compressed air return from the storage flasks to the compressor during unit shut down. All three stages of the compressor are protected by safety relief valves. Figure 1 provides a diagram of the compressor purification system. The compressor comes with two final system safety valves. One is set at 220 bar (3,200 psig), for use at 206 bar (3000 psig) operation. The other is set at 344 bar (5,000 psig) and use for higher operational pressures.

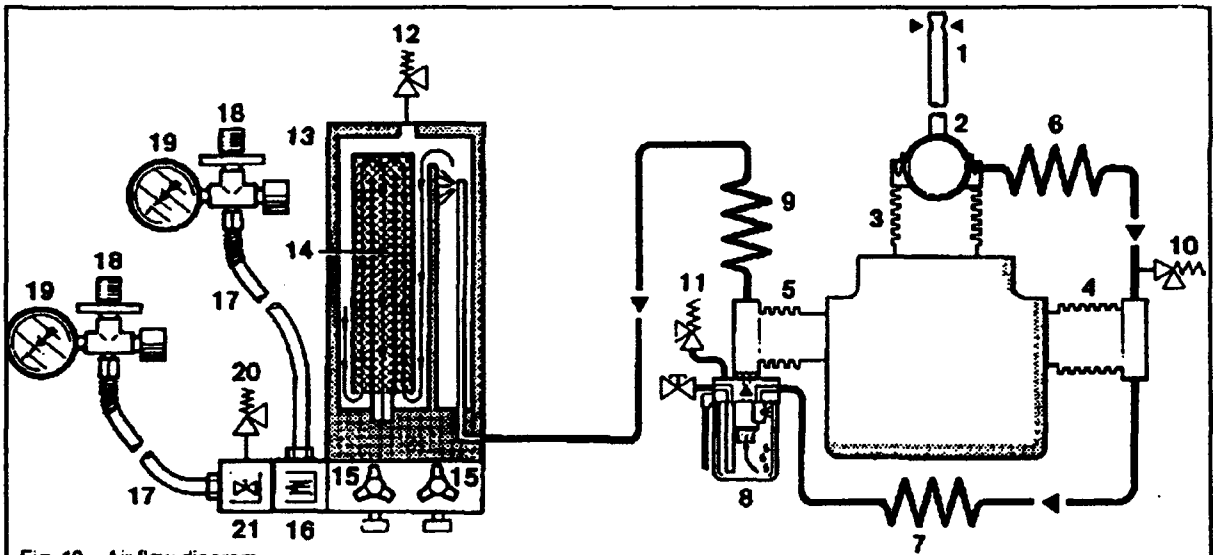

Fig. 10 Air flow diagram

1 Telescopic air intake
2 Intake filter
3 Cylinder 1st stage
4 Cylinder 2nd stage
5 Cylinder 3rd stage
6 Intercooler 1st/2nd stage
7 Intercooler 2nd/3rd stage
8 Intermediate filter, 2nd/3rd stage
9 Aftercooler
10 Safety valve 1st stage
11 Safety valve 2nd stage
12 Final safety valve
13 Central filter assy
14 TRIPLEX longlife cartridge
15 Condensate drain valve
16 Pressure maintaining valve
17 Filling hose
18 Filling valve
19 Final pressure gauge
20 Safety valve, final pressure PN 200
21 Change-over device*)

*) Optional

Figure 1

III. TEST PROCEDURE RESULTS

There are various methods of testing compressor capacities, stability and reliability[6]. For this compressor test, NEDU chose to run the compressor for extended periods at both 206 bar (3,000 psig) and 344 bar (5,000 psig) discharge pressure while injecting carbon monoxide (CO) into the compressor suction. Additionally, an 2,265 liter (80 cubic foot), 206 bar (3,000 psig) scuba cylinder was randomly charged from 0 to 206 bar (3,000 psig).

The compressor and all ancillary equipment were received and set up as per manufacturer's instructions. A Cole Palmer model 8502-14 temperature monitor and Yellow Springs Instruments 700 series thermistor probes were attached to measure compressor discharge and ambient temperatures. An Analox carbon monoxide monitor was used to analyze compressor discharge air before and after the compressor purification system. Nitrogen with a 50.8 PPM mixture of Carbon Monoxide (CO) was used to calibrate the high range of the CO monitor and ambient air was used to zero it. A gas mixture of 7% carbon monoxide and 93% nitrogen was injected into the compressor intake by a Victor Equipment Company manual regulator through a Fisher/Porter flow meter. The introduction of carbon monoxide was adjusted to maintain 50 PPM of carbon monoxide at the inlet to the central purification system. The unit was operated in an exterior work area, open to ambient temperature and humidity. A safety line was installed on the charging whip.

The compressor was operated using TRIPLEX cartridges (PN 59183-410) with molecular sieve, activated carbon, and hopcalite (2 cartridges at 206 bar (3,000 psig) and 1 cartridge at 344 bar (5,000 psig). The compressor was run until the cartridges no longer maintained carbon monoxide limits per reference[3]. The testing included subjective evaluation of the system operation but did not include detailed mechanical review of the individual components of the system. The compressor and engine were separated at the end of each day's testing. All supporting equipment was placed in the manufacturer's recommended transport position or secured for the following day's testing. The following parameters were recorded: Appendix A is recorded data from the Test Log.

1. Date.
2. Time.
3. Test hours.
4. Ambient temperature.
5. Compressor air discharge temperature.
6. Ambient humidity.
7. Carbon monoxide PPM before/after filtration.
8. Injected carbon monoxide flow rate and percentage.
9. Compressor discharge pressure.

10. Scuba cylinder charging times.

A. OIL LUBRICATION

At the beginning of the test, the engine and compressor oil sump levels measured full. Oil levels were checked at the beginning and end of each testing period. Oil levels were monitored during testing and oil consumption was logged in Appendix A. An engine and compressor oil change was accomplished (per manufacturer's recommendations) at 25 hours of unit operation. The oil used for the change was Anderol 500 compressor oil for the compressor and Navy symbol 9250 for the Honda engine. BAUER supplemental CAUTION sheet states:

"A Petroleum-based oil must be used for the first 25 hours of operation to assure proper seating of the piston rings. Synthetic oil may be installed at the first scheduled oil change". Anderol 500 is acceptable by BAUER as a synthetic oil.

B. OIL CONSUMPTION

During the 206 bar (3,000 psi) testing segment there was no noticeable oil consumption in ether unit. The 344 bar (5,000 psi) testing segment showed a total of 1/2 ounce compressor oil loss.

C. GASOLINE

The Honda GX160 gasoline engine is fitted with a 3.6 liter, 0.95 gallon fuel tank. The engine was run at full throttle during the entire testing period. Unleaded gasoline with a pump octane number of 86 or higher is recommended. A total of 59.8 liters, 15.8 gallons gasoline was used. During the evaluation the average run time on a tank of gas was 2 hours 50 minutes.

D. AIR SAMPLING

Each time a new purification cartridge was installed, an air sample was taken from the purification system discharge after the system had been operated for 1 hour running time. A second sample was taken when the cartridge failed or when the carbon monoxide exceeded the maximum allowable limit. Samples were sent to the Coastal Systems Station (CSS) Laboratory, code 5130, for purity analysis. Analysis of air sample are listed in Appendix B. Three filter cartridges were evaluated. Their effective life averaged 8 hours 40 minutes, exceeding the manufacturer's stated life expectancy. The times required to charge the scuba cylinder are recorded in Appendix A. An average of 26 minutes was needed to charge an 80 cubic foot cylinder from 0 to 206 bar (3,000 psig), for a rate of 3.0 cfm.

E. MAINTENANCE

Scheduled maintenance was performed per the manufacturer instructions. After 25 hours of operation the compressor intake filter was inspected for dirt, the engine/compressor oil was changed, and all external compressor components were inspected for wear and possible defects.

IV. OBSERVATIONS/RECOMMENDATIONS

A. The vendor and NAVSEA should be contacted prior to purchase to ensure the unit meets the user's needs.

B. An hour meter option should be available for military units to keep track of filter cartridge hours.

C. The compressor oil dip stick is extremely difficult to read. New oil is almost translucent and difficult to see on the stick. The description of the full mark is not clear in the manufacturer's technical manual. The compressor oil had to be drained and refilled with the recommended amount of oil (12 ounces, 354 milliliters) to determine the correct fill mark. It is recommended that the compressor oil dip stick should be replaced with a metal automotive type. A "full" and "add" mark between hatch lines for background imprinted on it would enhance its use.

D. The Honda engine oil dip stick is between the engine and compressor when the two units are coupled. The accessibility of the dip stick presents a personnel burn hazard if the oil is checked immediately after running. As the V-belt stretched from wear, the engine was no longer mounted horizontal to the compressor. The degree of offset from horizontal made reading the oil dip stick unreliable concerning the true full mark. It is recommended that for a true reading, the engine be removed from its compressor mounted torsion bar and placed on a flat horizontal surface to take the oil level reading.

E. The three manual condensate drain valves are spring-loaded to stay in the shut position, however the tension was not sufficient to hold the valves shut. The vibration of the running compressor would, on occasion, open the two central filter drain valves. Finally during the 344 bar (5,000 psi) testing segment, all drain valves had to be tightened to prevent leakage when operated.

F. The compressor operating and workshop instructions manuals provided were adequate with the following exceptions:

1. Paragraph 1.2 lists Figure 9 as the air flow diagram. The instruction pamphlet does not have a Figure 9. The flow diagram is actually in Figure 10. Change Figure 10 to Figure 9.

2. Paragraph 1.6, third sentence, is confusing. Change paragraph 1.6, third sentence to read: "Replace the safety valve when the blow-off pressure is too high or too low".

3. Paragraph 3.5 instructs the operator to drain the condensate from the interfilter, Figure 6, and from the central filter, Figure 7, by slowly opening drain valves. Figures 6 and 7 do not show drain valves. Add the drain valves, paragraph 3.5 references to figure 6 and 7 or reference Figure 10 for these valves.

4. Paragraph 3.3 regarding cartridge service life is incorrect. The operation instruction should be changed to reflect the current cartridge life.

5. The technical data pertaining to figure 10 is given in section 1.2, but nthe figure itself is found in section 4.2. Move Figure 10 under paragraph 1.2 so the reader can follow the illustration while reading the text.

WORKSHOP MANUAL

1. Used an abbreviation (F.A.D.) without a degination. Spell out abbreviations at least once in the document.

2. The torque setting listed for a M6 thread size is listed as 7.3 foot pound. This reading would be difficult to read on a standard torque wrench. It is recommended to change the torque setting listed for a M6 thread size to in. lb..

CONCLUSIONS

1. The BAUER UTILUS 10 Gasoline driven high pressure air compressor with the TRIPLEX purification system delivers acceptable breathing air at a capacity which meets the manufacturer's specification.

2. The unit is sturdy, reliable, and readily maintained.

3. The compressor package is particularly suitable for remote area scuba cylinder charging.

4. Based on the above BAUER UTILUS 10 gasoline driven high pressure air compressor with the TRIPLEX purification system is recommended for inclusion on the ANU list.

V. REFERENCES

1. NAVSEA Task 92-002; Evaluation of commercially available divers air compressors. Navy Experimental Diving Unit

2. NAVSEA Task 92-003; Evaluation of commercially available filters for H.P. and L.P. breathing air. Navy Experimental Diving Unit

3. NAVSEA 0994-LP-001-9010 U.S. Navy Diving Manual Volume 1 Para 5.3.2 Rev 2, 15 Dec 88. Air Purity Standards.

4. MIL-M-17060 E Amendment 1, sealed insulated systems, (service A use). Navy specification for compressor power source.

5. NAVAL SHIPS TECHNICAL MANUAL CHAPTER 551 COMPRESSED AIR PLANTS AND SYSTEMS S9086-SY-STM-010 PARA 551-4.2.2.1.

6. Navy Experimental Diving Unit Test Plan Number 93-01, Jan 93.

7. NAVSEAINST 10560.2B Authorized for Navy Use.

APPENDIX A - Test log

BAUER PURUS/UTILUS 10 MODEL U10-G H.P. COMPRESSOR

DATE 29 JUNE 1993

REAL TIME	TEST HOURS	TEMPS °F		AMBI HUMID %	CO/PPM CONCENTRATION		CO INJECTED INTO COMP. INTAKE		COMP DISH PRES	CHARGED CYLINDER SIZE		CYLINDER CHARGING INFORMATION			CYL FILL TIME
		AMBI TEMP °F	COMP DSCHG °F		BEFORE FILTER	AFTER FILTER	FLOW RATE	GAS %		RATED CUFT	RATED PSI	START TIME	END TIME	END PSI	
1115	0000	96°F	101°F	64%	53 PPM	N/A	.40 CC	7%	3,000						
1145	:30	94°F	103°F	64%	-	10.6 PPM	.40 CC	7%	3,000						
1200	:45	92°F	104°F	66%	-	3.2 PPM	.40 CC	7%	3,000						
1215	1:00	94°F	104°F	65%	-	2.4 PPM	.40 CC	7%	2,900						
1230	1:15	93°F	102°F	61%	45 PPM	-	.45 CC	7%	3,000						
1245	1:30	93°F	103°F	59%	50 PPM	-	.42 CC	7%	3,000						
1300	1:45	95°F	103°F	59%	48 PPM	-	.40 CC	7%	3,000						
1315	2:00	94°F	103°F	58%	51 PPM	-	.51 CC	7%	3,000	80 CUFT	3,000	1317			
1330	2:15	96°F	103°F	58%	-	5.2 PPM	.40 CC	7%	1,450	80 CUFT	3,000	-			
1345	2:30	95°F	105°F	58%	-	3.2 PPM	.40 CC	7%	3,000	80 CUFT	3,000	-	1345	3,000	:28

REMARKS
1100 Changed air filter to part No. 059183-410 ("O" rings were lubricated with halocarbon 25.5S)
1110 STARTED COMPRESSOR
1350 SECURED COMPRESSOR TESTING

NOTES: Compressor oil dip stick is not clearly marked. The instruction manual does not clarify this problem. The compressor oil was drained and refilled with 12 oz of oil (Bauer B1040) as per technical manual instructions. The dip stick was then marked for future reference. A discussion concerning the use of 2190 TEP type oil was conducted. It was determined that Anderol 500 will replace the manufacture recommended compressor oil.

BAUER PURUS/UTILUS 10 MODEL U10-G H.P. COMPRESSOR

DATE 6 JULY 1993

REAL TIME	TEST HOURS	TEMPS °F		AMBI HUMID %	CO/PPM CONCENTRATION		CO INJECTED INTO COMP. INTAKE		COMP DISH PRES	CHARGED CYLINDER SIZE		CYLINDER CHARGING INFORMATION			CYL FILL TIME
		AMBI TEMP °F	COMP DSCHG °F		BEFORE FILTER	AFTER FILTER	FLOW RATE	GAS %		RATED CUFT	RATED PSI	START TIME	END TIME	END PSI	
09:15	02:30	83°F	90°F	80%	50 PPM	-	.40 CC	7%	3,000						
09:30	02:45	83°F	94°F	70%	50 PPM	-	.50 CC	7%	3,000						
09:45	03:00	84°F	99°F	68%	50 PPM	7 PPM	.50 CC	7%	3,000	80 CUFT	3,000	0950			
10:00	03:15	86°F	99°F	65%	50 PPM	6 PPM	.50 CC	7%	1,200	80 CUFT	3,000				
10:15	03:30	90°F	100°F	62%	-	5 PPM	.50 CC	7%	3,000	80 CUFT	3,000		1015	3,000	:25
10:30	03:45	94°F	100°F	62%	50 PPM	-	.50 CC	7%	3,000						
10:45	04:00	94°F	101°F	62%	-	5 PPM	.50 CC	7%	3,000						
11:00	04:15	92°F	102°F	62%	-	6 PPM	.50 CC	7%	3,000	80 CUFT	3,000	1102			
11:15	04:30	90°F	101°F	62%	-	8 PPM	.50 CC	7%	1,200	80 CUFT	3,000		1128	3,000	:26
11:30	04:45	92°F	102°F	59%	-	7 PPM	.50 CC	7%	3,000						
11:45	05:00	92°F	102°F	55%	49 PPM	-	.50 CC	7%	3,000						
12:00	05:15	93°F	102°F	56%	48 PPM	-	.50 CC	7%	3,000						
12:15	05:30	94°F	101°F	57%	46 PPM	-	.50 CC	7%	3,000						
12:30	05:45	92°F	102°F	56%	50 PPM	-	.50 CC	7%	3,000						
12:45	06:00	91°F	104°F	58%	-	5 PPM	.50 CC	7%	3,000	80 CUFT	3,000	1245			
13:00	06:15	92°F	103°F	56%	-	6 PPM	.50 CC	7%	1,700	80 CUFT	3,000		1312	3,000	:27
13:15	06:30	90°F	104°F	57%	-	4 PPM	.50 CC	7%	3,000						
13:30	06:45	89°F	105°F	58%	-	4 PPM	.50 CC	7%	3,000						
13:45	07:00	91°F	106°F	56%	-	5 PPM	.50 CC	7%	3,000	80 CUFT	3,000	1345			
14:00	07:15	92°F	105°F	56%	-	11 PPM	.50 CC	7%	1,800	80 CUFT	3,000		1411	3,000	:26
14:15	07:30	92°F	107°F	53%	-	18 PPM	.50 CC	7%	3,000						

REMARKS
0915 CHECKED ENGINE & COMPRESSOR OIL
0915 STARTED COMPRESSOR
1154 OUT OF GAS
1200 STATED COMPRESSOR

BAUER PURUS/UTILUS 10 MODEL U10-G H.P. COMPRESSOR

DATE 7 JULY 1993

REAL TIME	1 ST HOURS	TEMPS °F		AMBI HUMID %	CO/PPM CONCENTRATION		CO INJECTED INTO COMP. INTAKE		COMP DISH PRES	CHARGED CYLINDER SIZE		CYLINDER CHARGING INFORMATION			CYL FILL TIME
		AMBI TEMP °F	COMP DSCHG °F		BEFORE FILTER	AFTER FILTER	FLOW RATE	GAS %		RATED CUFT	RATED PSI	START TIME	END TIME	END PSI	
08:45	07:30	90°F	94°F	69%	-	23 PPM	.50 CC	7%	3,000						
09:00	07:45	90°F	100°F	65%	-	19 PPM	.50 CC	7%	3,000						
09:45	08:00	92°F	100°F	62%	56 PPM	10 PPM	2.0 CC	7%	3,000						
10:00	08:15	89°F	100°F	64%	61 PPM	0 PPM	1.8 CC	7%	3,000						
10:15	08:30	89°F	100°F	65%	52 PPM	0 PPM-	2.0 CC	7%	3,000						
10:30	08:45	91°F	102°F	69%	40 PPM	0 PPM	2.2 CC	7%	3,000						
10:45	09:00	93°F	104°F	67%	48 PPM	0 PPM	2.4 CC	7%	3,000						
11:00	09:15	92°F	102°F	63%	51 PPM	10 PPM	2.6 CC	7%	3,000						
11:15	09:30	92°F	103°F	66%	-	26 PPM	2.5 CC	7%	3,000						
11:30	09:45	92°F	105°F	62%	-	38 PPM	2.5 CC	7%	3,000						
12:00	10:00	93°F	100°F	62%	47 PPM	-	2.1 CC	7%	3,000						

REMARKS
0835 CHECKED ENGINE & COMPRESSOR OIL
0840 STARTED COMPRESSOR
0900 SECURED COMPRESSOR
0925 STARTED COMPRESSOR
1130 OUT OF GAS & CHANGED FILTER 059183-410
1145 STATED COMPRESSOR
1205 SECURED COMPRESSOR

BAUER PURUS/UTILUS 10 MODEL U10-G H.P. COMPRESSOR

DATE 8 JULY 1993

REAL TIME	TEST HOURS	TEMPS °F		AMBI HUMID %	CO/PPM CONCENTRATION		CO INJECTED INTO COMP. INTAKE		COMP DISH PRES	CHARGED CYLINDER SIZE		CYLINDER CHARGING INFORMATION			CYL FILL TIME
		AMBI TEMP °F	COMP DSCHG °F		BEFORE FILTER	AFTER FILTER	FLOW RATE	GAS %		RATED CUFT	RATED PSI	START TIME	END TIME	END PSI	
08:15	10:00	80°F	87°F	83%	62 PPM	-	1.0 CC	7%	0						
08:30	10:15	82°F	88°F	78%	56 PPM	-	.85 CC	7%	3,000						
08:45	10:30	84°F	89°F	79%	54 PPM	-	.75 CC	7%	3,000	80 CUFT	3,000	0950			
09:00	10:45	84°F	90°F	77%	45 PPM	-	.68 CC	7%	3,000	80 CUFT	3,000				
09:15	11:00	86°F	92°F	76%	43 PPM	-	.68 CC	7%	3,000	80 CUFT	3,000		1015	3,000	:25
09:30	11:15	86°F	91°F	77%	44 PPM	-	.68 CC	7%	3,000						
09:45	11:30	86°F	92°F	75%	44 PPM	-	.72 CC	7%	3,000						
10:00	11:45	86°F	91°F	75%	48 PPM	-	.80 CC	7%	3,000						
10:15	12:00	87°F	96°F	75%	48 PPM	-	.80 CC	7%	3,000						
10:30	12:15	88°F	96°F	75%	-	2 PPM	.70 CC	7%	3,000	80 CUFT	3,000	10:30			
10:45	12:30	89°F	96°F	74%	-	2 PPM	.70 CC	7%	1,800				10:56	3,000	:26
11:00	12:45	90°F	99°F	74%	-	1 PPM	.70 CC	7%	3,000	80 CUFT	3,000	11:00			
11:15	13:00	90°F	98°F	72%	-	1 PPM	.70 CC	7%	1,800				11:27	3,000	:27
11:30	13:15	91°F	100°F	70%	-	1 PPM	.70 CC	7%	0	80 CUFT	3,000	11:30			
11:45	13:30	91°F	99°F	70%	-	1 PPM	.70 CC	7%	1,700				11:57	3,000	:27
12:00	13:45	92°F	102°F	69%	-	1 PPM	.70 CC	7%	3,000	80 CUFT	3,000	12:00			
12:15	14:00	92°F	101°F	67%	-	1 PPM	.70 CC	7%	1,750				12:27	3,000	:27
12:30	14:15	92°F	102°F	66%	-	1 PPM	.70 CC	7%	3,000	80 CUFT	3,000	12:30			
12:45	14:30	93°F	101°F	65%	-	2 PPM	.70 CC	7%	1,700				12:57	3,000	:27
13:00	14:45	93°F	103°F	67%	-	1 PPM	.70 CC	7%	3,000						

REMARKS
0800 CHECKED ENGINE, COMPRESSOR OIL
0810 STARTED COMPRESSOR
1030 FILLED GAS TANK
1305 SECURED COMPRESSOR (TESTING)

BAUER PURUS/UTILUS 10 MODEL U10-G H.P. COMPRESSOR

DATE 9 JULY 1993

REAL TIME	TEST HOURS	TEMPS °F		AMBI HUMID %	CO/PPM CONCENTRATION		CO INJECTED INTO COMP. INTAKE		COMP DISH PRES	CHARGED CYLINDER SIZE		CYLINDER CHARGING INFORMATION			CYL FILL TIME
		AMBI TEMP °F	COMP DSCHG °F		BEFORE FILTER	AFTER FILTER	FLOW RATE	GAS %		RATED CUFT	RATED PSI	START TIME	END TIME	END PSI	
08:30	14:45	83°F	85°F	85%	-	-	.70 CC	7%	0						
08:45	15:00	85°F	92°F	84%	53 PPM	-	.70 CC	7%	3,000						
09:00	15:15	86°F	92°F	83%	-	6 PPM	.70 CC	7%	3,000	80 CUFT	3,000	09:00			
09:15	15:30	87°F	94°F	82%	48 PPM	-	.70 CC	7%	1,600				09:27	3,000	:27
09:30	15:45	86°F	92°F	82%	45 PPM	-	.70 CC	7%	3,000	80 CUFT	3,000	09:30			
09:45	16:00	87°F	96°F	81%	-	2 PPM	.70 CC	7%	1,700				09:57	3,000	:27
10:00	16:15	89°F	100°F	78%	-	3 PPM	.70 CC	7%	3,000	80 CUFT	3,000	10:00			
10:15	16:30	90°F	98°F	76%	43 PPM	-	.70 CC	7%	1,700				10:26	3,000	:26
10:30	16:45	91°F	100°F	77%	43 PPM	-	.70 CC	7%	3,000	80 CUFT	3,000	10:30			
10:45	17:00	92°F	100°F	76%	-	10 PPM	.70 CC	7%	1,700				10:57	3,000	:27
11:00	17:15	94°F	101°F	78%	-	17 PPM	.70 CC	7%	3,000	80 CUFT	3,000	11:01			
11:15	17:30	94°F	102°F	77%	42 PPM	-	.70 CC	7%	1,650				11:28	3,000	:27
11:30	17:45	96°F	100°F	76%	39 PPM	-	.70 CC	7%	3,000	80 CUFT	3,000	11:30			
11:45	18:00	96°F	100°F	75%	-	32 PPM	.70 CC	7%	1,550				11:58	3,000	:28
12:00	18:15	97°F	102°F	75%	-	32 PPM	.70 CC	7%	3,000	80 CUFT	3,000	12:00			
12:15	18:30	96°F	106°F	73%	-	0 PPM	.70 CC	7%	1,700				12:27	3,000	:27
12:30	18:45	98°F	101°F	72%	51 PPM	-	.70 CC	7%	3,000	80 CUFT	3,000	12:30			
12:45	19:00	97°F	103°F	69%	-	46 PPM	.70 CC	7%	1,600				12:57	3,000	:27
13:00	19:15	97°F	105°F	65%	-	46 PPM	.70 CC	7%	3,000						

REMARKS
0800 CHECKED ENGINE, COMPRESSOR OIL
0815 FILLED GAS TANK
0830 STARTED COMPRESSOR
1305 SECURED COMPRESSOR (TESTING)

BAUER PURUS/UTILUS 10 MODEL U10-G H.P. COMPRESSOR

DATE 19 JULY 1993

REAL TIME	TEST HOURS	TEMPS °F		AMBI HUMID %	CO/PPM CONCENTRATION		CO INJECTED INTO COMP. INTAKE		COMP DISH PRES	CHARGED CYLINDER SIZE		CYLINDER CHARGING INFORMATION			CYL FILL TIME
		AMBI TEMP °F	COMP DSCHG °F		BEFORE FILTER	AFTER FILTER	FLOW RATE	GAS %		RATED CUFT	RATED PSI	START TIME	END TIME	END PSI	
09:45	19:15	83°F	-	70%											
10:00	19:30	85°F	92°F	73%	50 PPM	0 PPM	.50 CC	7%	3,000						
11:00	19:30	87°F	92°F	75%	50 PPM	0 PPM	.50 CC	7%	3,000						
11:15	19:45	87°F	94°F	77%	48 PPM	0 PPM	.60 CC	7%	3,000						
11:30	20:00	89°F	97°F	77%	47 PPM	0 PPM	.65 CC	7%	3,000						
11:45	20:15	88°F	91°F	75%	50 PPM	0 PPM	.65 CC	7%	2,500						
12:00	20:30	88°F	96°F	75%	50 PPM	0 PPM	.65 CC	7%	3,000	80 CUFT	3,000	12:01			
12:15	20:45	87°F	96°F	76%	50 PPM	0 PPM	.65 CC	7%	1,450				12:28	3,000	:27
12:30	21:00	88°F	106°F	78%	48 PPM	0 PPM	.65 CC	7%	3,000						
12:45	21:15	87°F	99°F	80%	50 PPM	0 PPM	.65 CC	7%	3,000						
13:00	21:30	88°F	95°F	80%	50 PPM	0 PPM	.65 CC	7%	1,300	80 CUFT	3,000	12:46			
13:15	21:45	87°F	99°F	80%	48 PPM	0 PPM	.65 CC	7%	3,000				13:13	3,000	:27
13:19	21:49	-	-	-	-	-	-	-	-						
13:24	21:49	88°F	94°F	80%	-	-	-	-	-						
13:30	21:55	89°F	95°F	84%	51 PPM	-	.64 CC	7%	3,000						
13:45	22:10	89°F	99°F	84%	50 PPM	8 PPM	.65 CC	7%	3,000						
14:00	22:25	89°F	101°F	84%	50 PPM	1 PPM	.64 CC	7%	3,000						
14:15	22:40	89°F	102°F	82%	50 PPM	0 PPM	.64 CC	7%	3,000						
14:30	22:55	90°F	101°F	80%	50 PPM	0 PPM	.64 CC	7%	3,000						
14:45	23:10	90°F	99°F	80%	48 PPM	0 PPM	.64 CC	7%	3,000						

REMARKS

0845 CHECKED ENGINE, COMPRESSOR OIL
0900 CHANGED FILTER TO PART No. 059183-410
("O" rings were lubricated with halocarbon 25.5S)
0905 FILLED GAS TANK
0940 STARTED COMPRESSOR 0945 STARTED TESTING 1230 AIR SAMPLE TAKEN 1319 ENGINE STOPPED (OUT OF GAS)
1324 RE-STARTED TESTING
1446 SECURED COMPRESSOR (TESTING)

BAUER PURUS/UTILUS 10 MODEL U10-G H.P. COMPRESSOR

DATE 20 JULY 1993

REAL TIME	TEST HOURS	TEMPS °F		AMBI HUMID %	CO/PPM CONCENTRATION		CO INJECTED INTO COMP. INTAKE		COMP DISH PRES	CHARGED CYLINDER SIZE		CYLINDER CHARGING INFORMATION			CYL FILL TIME
		AMBI TEMP °F	COMP DSCHG °F		BEFORE FILTER	AFTER FILTER	FLOW RATE	GAS %		RATED CUFT	RATED PSI	START TIME	END TIME	END PSI	
08:00	23:10	82°F	82°F	92%	-	-	-	-	-						
08:15	23:25	83°F	87°F	83%	50 PPM	0 PPM	.64 CC	7%	3,000						
08:30	23:40	84°F	87°F	77%	45 PPM	0 PPM	.75 CC	7%	3,000						
08:45	23:55	85°F	88°F	73%	48 PPM	0 PPM	.75 CC	7%	3,000						
09:00	24:10	85°F	94°F	71%	47 PPM	0 PPM	.75 CC	7%	3,000						
09:15	24:25	86°F	95°F	70%	50 PPM	0 PPM	.75 CC	7%	2,500						
09:30	24:40	85°F	94°F	70%	50 PPM	0 PPM	.75 CC	7%	3,000						
09:31	24:41	-	-	-	-	-	-	-	-						
09:32	24:41	85°F	-	70%	-	-	.75 CC	7%	0						
09:45	24:54	86°F	95°F	65%	50 PPM	1 PPM	.75 CC	7%	3,000						
10:00	25:09	88°F	94°F	66%	50 PPM	0 PPM	.75 CC	7%	3,000						
10:30	25:15	87°F	92°F	72%	48 PPM	0 PPM	.75 CC	7%	3,000	80 CUFT	3,000	10:31			
10:45	25:30	88°F	97°F	72%	50 PPM	0 PPM	.75 PPM	7%	1,250				10:56	3,000	:25
11:00	25:45	88°F	103°F	73%	50 PPM	0 PPM	.75 PPM	7%	3,000						
11:08	25:53	89°F	95°F	73%	51 PPM	-	-	-	-						
11:39	25:53	89°F	94°F	73%	50 PPM	-	.75 PPM	7%	0						
11:45	25:59	89°F	94°F	72%	52 PPM	0 PPM	.70 CC	7%	3,000						
12:00	26:14	88°F	99°F	72%	50 PPM	0 PPM	.60 CC	7%	3,000	80 CUFT	3,000	12:00			

BAUER PURUS/UTILUS 10 MODEL U10-G H.P. COMPRESSOR

DATE 20 JULY 1993

REAL TIME	TEST HOURS	TEMPS °F		AMBI HUMID %	CO/PPM CONCENTRATION		CO INJECTED INTO COMP. INTAKE		COMP DISH PRES	CHARGED CYLINDER SIZE		CYLINDER CHARGING INFORMATION			CYL FILL TIME
		AMBI TEMP °F	COMP DSCHG °F		BEFORE FILTER	AFTER FILTER	FLOW RATE	GAS %		RATED CUFT	RATED PSI	START TIME	END TIME	END PSI	
12:15	26:29	89°F	100°F	75%	50 PPM	0 PPM	.60 CC	. 7%	1,700	-	-		12:26	3,000	:26
12:30	26:44	88°F	99°F	77%	50 PPM	0 PPM	.60 CC	7%	3,000	-	-				
12:45	26:59	88°F	101°F	77%	50 PPM	0 PPM	.60 CC	7%	3,000	80 CUFT	3,000	12:48			
13:01	27:15	88°F	98°F	79%	50 PPM	0 PPM	.60 CC	7%	1,450				13:14	3,000	:26
13:15	27:29	88°F	99°F	80%	50 PPM	1 PPM	.60 CC	7%	3,000						
13:27	27:40	86°F	-	-	-	-	-	-	-						
13:29	27:40	86°F	97°F	79%	50 PPM	0 PPM	.60 CC	7%	0						
13:30	27:41	88°F	91°F	79%	50 PPM	1 PPM	.60 CC	7%	3,000						
13:37	27.48	89°F	91°F	79%	50 PPM	27 PPM	.60 CC	7%	3,000						

REMARKS
0745 CHECKED ENGINE AND COMPRESSOR OIL
0758 STARTED COMPRESSOR
0931 ENGINE STOPPED (OUT OF GAS)
0932 STARTED ENGINE
1108 STOPPED ENGINE, 25 HOUR OIL CHANGE (CHANGE ENGINE OIL WITH NAVY 9250 TYPE)
1139 RE-STARTED COMPRESSOR
1327 ENGINE STOPPED (OUT OF GAS)
1329 RE-STARTED COMPRESSOR
1337 AIR SAMPLE TAKEN

BAUER PURUS/UTILUS 10 MODEL U10-G H.P. COMPRESSOR

DATE 21 JULY 1993

REAL TIME	TEST HOURS	TEMPS °F		AMBI HUMID %	CO/PPM CONCENTRATION		CO INJECTED INTO COMP. INTAKE		COMP DISH PRES	CHARGED CYLINDER SIZE		CYLINDER CHARGING INFORMATION			CYL FILL TIME
		AMBI TEMP °F	COMP DSCHG °F		BEFORE FILTER	AFTER FILTER	FLOW RATE	GAS %		RATED CUFT	RATED PSI	START TIME	END TIME	END PSI	
08:00	27:48	83°F	88°F	85%	50 PPM	0 PPM	.75 CC	7%	3,000						
08:15	28:03	-	-	-	-	-	-	-	-						
08:45	28:03	84°F	86°F	77%	40 PPM	0 PPM	.85 CC	7%	0						
09:00	28:18	86°F	90°F	65%	32 PPM	0 PPM	1.0 CC	7%	3,000						
09:15	28:33	85°F	89°F	70%	50 PPM	0 PPM	1.1 CC	7%	3,000						
09:30	28:48	87°F	94°F	68%	49 PPM	0 PPM	1.1 CC	7%	3,000	80 CUFT	3,000	09:35			
09:45	29:03	84°F	91°F	71%	49 PPM	0 PPM	1.1 CC	7%	1,200						
10:00	29:18	85°F	96°F	59%	49 PPM	0 PPM	1.1 CC	7%	2,800				10:01	3,000	:26
10:15	29:33	86°F	88°F	64%	47 PPM	0 PPM	1.1 CC	7%	3,000						
10:30	29:48	89°F	93°F	70%	48 PPM	0 PPM	1.1 CC	7%	3,000	80 CUFT	3,000	10:31			
10:45	30:03	88°F	98°F	71%	49 PPM	0 PPM	1.1 CC	7%	2,000				10:57	3,000	:26
11:00	30:18	88°F	102°F	74%	50 PPM	0 PPM	1.1 CC	7%	3,000						
11:09	30:27	-	-	-	-	-	-	-	-						
11:11	30:27	88°F	95°F	73%	50 PPM	0 PPM	1.1 PPM	7%	0						
11:15	30:31	89°F	93°F	73%	49 PPM	0 PPM	1.1 PPM	7%	3,000						
11:30	30:46	87°F	94°F	69%	48 PPM	0 PPM	1.1 PPM	7%	3,000	80 CUFT	3,000	11:30			
11:45	31:01	88°F	96°F	75%	49 PPM	0 PPM	1.1 CC	7%	1,800				11:57	3,000	:27
12:00	31:16	90°F	99°F	76%	49 PPM	0 PPM	1.1 CC	7%	3,000						

BAUER PURUS/UTILUS 10 MODEL U10-G H.P. COMPRESSOR

DATE 21 JULY 1993

REAL TIME	TEST HOURS	TEMPS °F		AMBI HUMID %	CO/PPM CONCENTRATION		CO INJECTED INTO COMP. INTAKE		COMP DISH PRES	CHARGED CYLINDER SIZE		CYLINDER CHARGING INFORMATION			CYL FILL TIME
		AMBI TEMP °F	COMP DSCHG °F		BEFORE FILTER	AFTER FILTER	FLOW RATE	GAS %		RATED CUFT	RATED PSI	START TIME	END TIME	END PSI	
12:15	31:31	90°F	94°F	76%	46 PPM	0 PPM	1.1 CC	7%	3,000	80 CUFT	3,000	12:21			
12:30	31:46	89°F	96°F	77%	48 PPM	0 PPM	1.1 CC	7%	1,200						
12:45	32:01	88°F	99°F	77%	49 PPM	0 PPM	1.1 CC	7%	2,700				12:47	3,000	:26
13:00	32:16	89°F	100°F	76%	49 PPM	0 PPM	1.1 CC	7%	3,000						
13:15	32:31	89°F	98°F	77%	49 PPM	0 PPM	1.1 CC	7%	3,000						
13:30	32:46	89°F	99°F	77%	49 PPM	0 PPM	1.1 CC	7%	3,000						
13:45	33:01	88°F	98°F	78%	50 PPM	0 PPM	1.1 CC	7%	3,000						
14:00	33:16	88°F	100°F	77%	49 PPM	0 PPM	1.1 CC	7%	3,000						
14:15	33:31	90°F	101°F	77%	50 PPM	0 PPM	1.1 CC	7%	3,000						

REMARKS
0730 CHECK ENGINE/COMPRESSOR OIL
0745 CHANGED FILTER TO PART No. 059183-410 ("O" rings were lubricated with halocarbon 25.5S)
0750 STARTED COMPRESSOR
0815 SECURED COMPRESSOR
0845 STARTED COMPRESSOR
0915 AIR SAMPLE TAKEN
1109 SECURED ENGINE (OUT OF GAS, 03:02 ON THIS TANK)
1111 STARTED ENGINE
1416 SECURED COMPRESSOR

BAUER PURUS/UTILUS 10 MODEL U10-G H.P. COMPRESSOR

DATE 26 JULY 1993

REAL TIME	TEST HOURS	TEMPS °F		AMBI HUMID %	CO/PPM CONCENTRATION		CO INJECTED INTO COMP. INTAKE		COMP DISH PRES	CHARGED CYLINDER SIZE		CYLINDER CHARGING INFORMATION			CYL FILL TIME
		AMBI TEMP °F	COMP DSCHG °F		BEFORE FILTER	AFTER FILTER	FLOW RATE	GAS %		RATED CUFT	RATED PSI	START TIME	END TIME	END PSI	
09:15	33:31	90°F	98°F	80%	51 PPM	-	1.0 CC	7%	3,000						
09:30	33:46	91°F	94°F	77%	50 PPM	-	1.0 CC	7%	3,000						
09:45	34:01	95°F	97°F	66%	50 PPM	3 PPM	.90 CC	7%	3,000						
10:00	34:16	88°F	98°F	62%	50 PPM	2 PPM	1.1 CC	7%	3,000						
10:15	34:31	87°F	99°F	74%	50 PPM	0 PPM	1.1 CC	7%	3,000						
10:30	34:46	87°F	96°F	75%	50 PPM	0 PPM	1.1 CC	7%	3,000	80 CUFT	3,000	10:31			
10:45	35:01	87°F	96°F	77%	50 PPM	0 PPM	1.1 CC	7%	1,700				10:58	3,000	:27
11:00	35:16	88°F	104°F	72%	50 PPM	0 PPM	1.1 CC	7%	3,000						
11:15	35:31	88°F	101°F	73%	50 PPM	0 PPM	1.1 CC	7%	3,000	80 CUFT	3,000	11:17			
11:30	35:46	88°F	99°F	65%	50 PPM	0 PPM	1.1 CC	7%	1,500				11:43	3,000	:26
11:45	36:01	89°F	103°F	73%	50 PPM	0 PPM	1.1 CC	7%	3,000						
12:00	36:16	88°F	101°F	74%	50 PPM	13 PPM	1.1 CC	7%	3,000						

REMARKS
0840 CHECKED ENGINE/COMPRESSOR OIL
0905 FILLED GAS TANK
0910 STARTED COMPRESSOR
1200 AIR SAMPLE TAKEN
1202 SECURED COMPRESSOR

BAUER PURUS/UTILUS 10 MODEL U10-G H.P. COMPRESSOR

DATE 03 AUGUST 1993

REAL TIME	TEST HOURS	TEMPS °F		AMBI HUMID %	CO/PPM CONCENTRATION		CO INJECTED INTO COMP. INTAKE		COMP DISH PRES	CHARGED CYLINDER SIZE		CYLINDER CHARGING INFORMATION			CYL FILL TIME
		AMBI TEMP °F	COMP DSCHG °F		BEFORE FILTER	AFTER FILTER	FLOW RATE	GAS %		RATED CUFT	RATED PSI	START TIME	END TIME	END PSI	
09:15	41:01	98°F	94°F	59%	50 PPM	-	.80 CC	7%	5,000						
09:30	41:16	100°F	105°F	55%	50 PPM	16.2 PPM	.80 CC	7%	5,000						
09:45	41:31	99°F	100°F	54%	50 PPM	14.9 PPM	.80 CC	7%	5,000						
10:00	41:46	96°F	102°F	56%	50 PPM	9.0 PPM	.80 CC	7%	5,000						
10:15	42:01	93°F	101°F	59%	50 PPM	9.0 PPM	.80 CC	7%	5,000						
10:30	42:16	93°F	102°F	64%	50 PPM	9.8 PPM	.80 CC	7%	5,000						
10:45	42:31	90°F	103°F	67%	50 PPM	8.9 PPM	.80 CC	7%	5,000						
11:00	42:46	93°F	101°F	68%	50 PPM	9.0 PPM	.80 CC	7%	5,000						
11:15	43:01	94°F	101°F	67%	50 PPM	10.0 PPM	.80 CC	7%	5,000						
11:30	43:16	92°F	102°F	62%	50 PPM	10.1 PPM	.80 CC	7%	5,000						
11:45	43:31	92°F	102°F	65%	50 PPM	9.8 PPM	.80 CC	7%	5,000						
12:00	43:46	92°F	103°F	64%	50 PPM	19.0 PPM	.80 CC	7%	5,000						
12:15	44:01	93°F	105°F	66%	50 PPM	19.2 PPM	.80 CC	7%	5,000						
12:30	44:16	93°F	104°F	66%	50 PPM	19.4 PPM	.80 CC	7%	5,000						
12:45	44:31	93°F	104°F	67%	50 PPM	18.7 PPM	.80 CC	7%	5,000						
13:00	44:46	93°F	103°F	70%	50 PPM	18.9 PPM	.80 CC	7%	5,000						
13:15	45:01	93°F	102°F	69%	50 PPM	22.3PPM	.80 CC	7%	5,000						

REMARKS
0830 CHECKED ENGINE/COMPRESSOR OIL (ADDED 1/2 OUNCE OIL TO COMPRESSOR)
0908 STARTED COMPRESSOR
1315 AIR SAMPLE TAKEN
1316 SECURED COMPRESSOR

Memorandum 20 JULY 1993

To: Dave Sullivan, NEDU

From: Glen Deason, Code 2530

Subject: Analysis of air sample marked Buauer Unius Compressor Test. 93-01 Second Cartridge, 1 hour.

1. In accordance with your request, the air sample delivered to the gas analysis lab was analyzed and found to contain:

Standard Components

Component	Level	Limit
Oxygen	21.0%	20-22%***
Nitrogen	78.1%	NONE***
Argon	0.9%	NONE***
Carbon Dioxide	408.0 PPM	1000PPM***
Total Hydrocarbons*	2.5 PPM	25 PPM**
Carbon Monoxide	1.0 PPM	20 PPM**
Methane	2.5 PPM	1000 PPM**
Acetone	<0.1 PPM	200 PPM***
Benzene	<0.1 PPM	1 PPM***
Chloroform	<0.1 PPM	1 PPM***
Ethanol	<0.1 PPM	100 PPM***
Freon 113	<0.1 PPM	100 PPM***
Freon 11	<0.1 PPM	100 PPM***
Freon 12	<0.1 PPM	100 PPM***
Freon 114	<0.1 PPM	100 PPM***
Isopropyl Alcohol	<0.1 PPM	1 PPM***
Methanol	<0.1 PPM	10 PPM***
Methyl Chloroform	<0.1 PPM	30 PPM***
Methyl Ethyl Ketone	<0.1 PPM	20 PPM***
Methyl Isobutyl Ketone	<0.1 PPM	20 PPM***
Methylene Chloride	<0.1 PPM	25 PPM***
Toluene	<0.1 PPM	20 PPM***
Trimethyl Benzenes	<0.1 PPM	3 PPM***
Xylenes	<0.1 PPM	50 PPM***

Other Components

Component	Level	Limit
NONE		
C4+	<0.1 PPM	NONE

*Expressed as methane equivalents.
**Limits taken from process instruction #0558-839.
***Limits taken from Navy Dive Manual; Vol. 2, Rev. 3.
**** OSHA Final Rule limits published as of July 1992 (not specified in Navy Dive Manual).

2. The above sample did not show appreciable contamination; all components were within the acceptable range.

Glen Deason HBOO

Glen Deason
Chemist

Memorandum 21 JULY 1993

To: Dave Sullivan, NEDU

From: Glen Deason, Code 2530

Subject: Analysis of air sample marked Buauer Unius Compressor Test. 93-01 Second Cartridge, 8 hour sample.

1. In accordance with your request, the air sample delivered to the gas analysis lab was analyzed and found to contain:

Standard Components

Component	Level	Limit
Oxygen	21.0%	20-22%***
Nitrogen	78.1%	NONE***
Argon	0.9%	NONE***
Carbon Dioxide	153.0 PPM	1000PPM***
Total Hydrocarbons*	2.4 PPM	25 PPM**
Carbon Monoxide	32.6 PPM	20 PPM**
Methane	2.4 PPM	1000 PPM**
Acetone	<0.1 PPM	200 PPM***
Benzene	<0.1 PPM	1 PPM***
Chloroform	<0.1 PPM	1 PPM***
Ethanol	<0.1 PPM	100 PPM***
Freon 113	<0.1 PPM	100 PPM***
Freon 11	<0.1 PPM	100 PPM***
Freon 12	<0.1 PPM	100 PPM***
Freon 114	<0.1 PPM	100 PPM***
Isopropyl Alcohol	<0.1 PPM	1 PPM***
Methanol	<0.1 PPM	10 PPM***
Methyl Chloroform	<0.1 PPM	30 PPM***
Methyl Ethyl Ketone	<0.1 PPM	20 PPM***
Methyl Isobutyl Ketone	<0.1 PPM	20 PPM***
Methylene Chloride	<0.1 PPM	25 PPM***
Toluene	<0.1 PPM	20 PPM***
Trimethyl Benzenes	<0.1 PPM	3 PPM***
Xylenes	<0.1 PPM	50 PPM***

Other Components

Component	Level	Limit
NONE		

C4+	<0.1 PPM	NONE

*Expressed as methane equivalents.
**Limits taken from process instruction #0558-839.
***Limits taken from Navy Dive Manual; Vol. 2, Rev. 3.
**** OSHA Final Rule limits published as of July 1992 (not specified in Navy Dive Manual).

2. The above sample showed appreciable contamination; all other components were within the acceptable range.

Glen Deason HSE

Glen Deason
Chemist

Memorandum 21 JULY 1993

To: Dave Sullivan, NEDU

From: Glen Deason, Code 2530

Subject: Analysis of air sample marked Buauer Unius Compressor Test. 93-01 Third Cartridge, 1 hour sample.

1. In accordance with your request, the air sample delivered to the gas analysis lab was analyzed and found to contain:

Standard Components

Component	Level	Limit
Oxygen	21.0%	20-22%***
Nitrogen	78.1%	NONE***
Argon	0.9%	NONE***
Carbon Dioxide	52.0 PPM	1000PPM***
Total Hydrocarbons*	1.8 PPM	25 PPM**
Carbon Monoxide	<0.5 PPM	20 PPM**
Methane	1.8 PPM	1000 PPM**
Acetone	<0.1 PPM	200 PPM***
Benzene	<0.1 PPM	1 PPM***
Chloroform	<0.1 PPM	1 PPM***
Ethanol	<0.1 PPM	100 PPM***
Freon 113	<0.1 PPM	100 PPM***
Freon 11	<0.1 PPM	100 PPM***
Freon 12	<0.1 PPM	100 PPM***
Freon 114	<0.1 PPM	100 PPM***
Isopropyl Alcohol	<0.1 PPM	1 PPM***
Methanol	<0.1 PPM	10 PPM***
Methyl Chloroform	<0.1 PPM	30 PPM***
Methyl Ethyl Ketone	<0.1 PPM	20 PPM***
Methyl Isobutyl Ketone	<0.1 PPM	20 PPM***
Methylene Chloride	<0.1 PPM	25 PPM***
Toluene	<0.1 PPM	20 PPM***
Trimethyl Benzenes	<0.1 PPM	3 PPM***
Xylenes	<0.1 PPM	50 PPM***

Other Components

Component	Level	Limit
NONE		

C4+	<0.1 PPM	NONE

*Expressed as methane equivalents.
**Limits taken from process instruction #0558-839.
***Limits taken from Navy Dive Manual; Vol. 2, Rev. 3.
**** OSHA Final Rule limits published as of July 1992 (not specified in Navy Dive Manual).

2. The above sample did not show appreciable contamination; all other components were within the acceptable range.

Glen Deason HBO
Glen Deason
Chemist

Memorandum 26 JULY 1993

To: Dave Sullivan, NEDU

From: Glen Deason, Code 2530

Subject: Analysis of air sample taken from Bauer Utilus Compressor Test 93-1 Third Cartridge 8 hour sample.

1. In accordance with your request, the air sample delivered to the gas analysis lab was analyzed and found to contain:

Standard Components

Component	Level	Limit
Oxygen	21%	20-22%***
Nitrogen	78.1%	NONE***
Argon	0.9%	NONE***
Carbon Dioxide	268 PPM	1000 PPM***
Total Hydrocarbons*	2.3 PPM	25 PPM**
Carbon Monoxide	30.7 PPM	20 PPM**
Methane	2.3 PPM	1000 PPM**
Acetone	<0.1 PPM	200 PPM***
Benzene	<0.1 PPM	1 PPM***
Chloroform	<0.1 PPM	1 PPM***
Ethanol	<0.1 PPM	100 PPM***
Freon 113	<0.1 PPM	100 PPM***
Freon 11	<0.1 PPM	100 PPM***
Freon 12	<0.1 PPM	100 PPM***
Freon 114	<0.1 PPM	100 PPM***
Isopropyl Alcohol	<0.1 PPM	1 PPM***
Methanol	<0.1 PPM	10 PPM***
Methyl Chloroform	<0.1 PPM	30 PPM***
Methyl Ethyl Ketone	<0.1 PPM	20 PPM***
Methyl Isobutyl Ketone	<0.1 PPM	20 PPM***
Methylene Chloride	<0.1 PPM	25 PPM***
Toluene	<0.1 PPM	20 PPM***
Trimethyl Benzenes	<0.1 PPM	3 PPM***
Xylenes	<0.1 PPM	50 PPM***

Other Components

Component	Level	Limit
NONE		

C4+	<0.1 PPM	NONE

*Expressed as methane equivalents.
**Limits taken from process instruction #0558-839.
***Limits taken from Navy Dive Manual; Vol. 2, Rev. 3.
**** OSHA Final Rule limits published as of July 1992 (not specified in Navy Dive Manual).

2. The above sample showed appreciable contamination; all components were not within the acceptable range.

Glen Deason HBA

Glen Deason
Chemist

Memorandum 2 AUGUST 1993

To: Dave Sullivan, NEDU

From: Glen Deason, Code 2530

Subject: Analysis of air sample marked Bauer Utilus Evalation 1-Hour sample. NEDU TEST 93-1. 6000 PSI 6 1 HOUR SAMPLE

1. In accordance with your request, the air sample delivered to the gas analysis lab was analyzed and found to contain:

Standard Components

Component	Level	Limit
Oxygen	21.0%	20-22%***
Nitrogen	78.1%	NONE***
Argon	0.9%	NONE***
Carbon Dioxide	213.0 PPM	1000 PPM***
Total Hydrocarbons*	2.4 PPM	25 PPM**
Carbon Monoxide	9.3 PPM	20 PPM**
Methane	2.4 PPM	1000 PPM**
Acetone	<0.1 PPM	200 PPM***
Benzene	<0.1 PPM	1 PPM***
Chloroform	<0.1 PPM	1 PPM***
Ethanol	<0.1 PPM	100 PPM***
Freon 113	<0.1 PPM	100 PPM***
Freon 11	<0.1 PPM	100 PPM***
Freon 12	<0.1 PPM	100 PPM***
Freon 114	<0.1 PPM	100 PPM***
Isopropyl Alcohol	<0.1 PPM	1 PPM***
Methanol	<0.1 PPM	10 PPM***
Methyl Chloroform	<0.1 PPM	30 PPM***
Methyl Ethyl Ketone	<0.1 PPM	20 PPM***
Methyl Isobutyl Ketone	<0.1 PPM	20 PPM***
Methylene Chloride	<0.1 PPM	25 PPM***
Toluene	<0.1 PPM	20 PPM***
Trimethyl Benzenes	<0.1 PPM	3 PPM***
Xylenes	<0.1 PPM	50 PPM***

Other Components

Component	Level	Limit
NONE		

C4+	<0.1 PPM	NONE

*Expressed as methane equivalents.
**Limits taken from process instruction #0558-839.
***Limits taken from Navy Dive Manual; Vol. 2, Rev. 3.
**** OSHA Final Rule limits published as of July 1992 (not specified in Navy Dive Manual).

2. The above sample did not show appreciable contamination; all components were within the acceptable range.

Glen Deason
Chemist

Memorandum 4 AUGUST 1993

To: Dave Sullivan, NEDU

From: Glen Deason, Code 2530

Subject: Analysis of air sample taken from Bauer Utilus Compressor Test 93-1. 9 hour sample. NEDU TEST 93-1. 5,000 PSIG

1. In accordance with your request, the air sample delivered to the gas analysis lab was analyzed and found to contain:

Standard Components

Component	Level	Limit
Oxygen	21%	20-22%***
Nitrogen	78.1%	NONE***
Argon	0.9%	NONE***
Carbon Dioxide	248 PPM	1000 PPM***
Total Hydrocarbons*	2.4 PPM	25 PPM**
Carbon Monoxide	46.8 PPM	20 PPM**
Methane	2.4 PPM	1000 PPM**
Acetone	<0.1 PPM	200 PPM***
Benzene	<0.1 PPM	1 PPM***
Chloroform	<0.1 PPM	1 PPM***
Ethanol	<0.1 PPM	100 PPM***
Freon 113	<0.1 PPM	100 PPM***
Freon 11	<0.1 PPM	100 PPM***
Freon 12	<0.1 PPM	100 PPM***
Freon 114	<0.1 PPM	100 PPM***
Isopropyl Alcohol	<0.1 PPM	1 PPM***
Methanol	<0.1 PPM	10 PPM***
Methyl Chloroform	<0.1 PPM	30 PPM***
Methyl Ethyl Ketone	<0.1 PPM	20 PPM***
Methyl Isobutyl Ketone	<0.1 PPM	20 PPM***
Methylene Chloride	<0.1 PPM	25 PPM***
Toluene	<0.1 PPM	20 PPM***
Trimethyl Benzenes	<0.1 PPM	3 PPM***
Xylenes	<0.1 PPM	50 PPM***

Other Components

Component	Level	Limit
NONE		

C4+	<0.1 PPM	NONE

*Expressed as methane equivalents.
**Limits taken from process instruction #0558-839.
***Limits taken from Navy Dive Manual; Vol. 2, Rev. 3.
**** OSHA Final Rule limits published as of July 1992 (not specified in Navy Dive Manual).

2. The above sample showed appreciable contamination; all components were not within the acceptable range.

Glen Deason
Chemist